

(No. 9 Sept. 1995)

California's size, terrain and cultural complexity present formidable communications challenges to this Department. The CDF radio system which exists today is as reliable and sophisticated as limited budget dollars will allow. It is impossible, given the fiscal problems confronting our state, to continually stay current with state-of-the-art equipment offered by the fast-moving telecommunications industry. The Department's fire protection and telecommunications staff are charged with providing the best equipment possible, within budget limits. It is incumbent upon each and every radio user to understand the basics of the system, to be thoroughly familiar with correct operation of assigned radios, and to exercise self-discipline in all radio transmissions. There is no room on the system for trivia, horseplay, obscenities or unnecessary traffic, nor will they be tolerated. Although ECCs are the everyday system managers and will take action to stop or correct misuse, the fundamental responsibility for good radio etiquette remains with the individual employee.

The CDF radio system is a two-way, mobile relay and simplex (car-to-car) system based in the VHF spectrum, with research and development ongoing in other frequency bands. All system hardware is planned, purchased, distributed and replaced in accordance with policies established by fire protection staff and the Telecommunications Division of the Department of General Services. Field units, through normal channels of communication and their regional COMPLAC member, have the opportunity to suggest improvements, evaluate new products, and assist in long-range planning and implementation.

CDF's authorized radio frequencies, as assigned by the Federal Communications Commission (FCC), are derived from a block of frequencies designated for use by the Forestry-Conservation radio service. The Forestry-Conservation frequencies in California are shared by CDF, the Department of Water Resources, the Department of Fish and Game, the Department of Parks and Recreation, various flood control and parks and recreation districts, and agencies in adjoining states. Geographic separation of these frequencies is becoming more complex each year. It is very important that serious radio interference be promptly reported through command/coordination center channels to HQ telecommunications management.

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Mobile Relay (Repeater)

A mobile relay automatically retransmits radio signals it receives to extend the range of other radio equipment (usually mobiles). In order to minimize interference all CDF mobile relays use a 151/159 MHz frequency pair. It receives 159 MHz signals; if the signal is accompanied by the tone that the relay is programmed to accept, it simultaneously retransmits the signal on a 151 MHz frequency. If a lookout is co-located with a mobile relay, the lookout may use the mobile relay as a base station.

Since CDF has multiple repeaters for its local and other nets, and it is undesirable for a signal to activate more than one repeater at a time, CTCSS (continuous tone controlled squelch system) subaudible tones are used to selectively activate desired repeaters. The eight CTCSS tones used help to minimize co-channel interference between units. Also, CDF repeaters have low transmit power, normally 35 watts, to further reduce the chance of shared frequencies overriding each other.

Permanently installed mobile relays are limited, normally, to single channel operation. Portable mobile relays can be switched to any CDF repeater frequency, including cross-net operations. A limited number of permanent repeaters are capable of being switched by tone signal from one net to another.

Base Stations

Base station is a radio transceiver assigned to a fixed location (not mobile) for "base-to-base" or "base-to-mobile" communications, and sometimes capable of multi-frequency operation.

A base station transmits on a 159 MHz frequency with a tone leading the transmission for mobile relay use or on a 151 MHz frequency without tone, for simplex or car-to-car use. It receives a 151 MHz frequency. Lookouts using a mobile relay as a base station transmit on a 151 Mhz without tone, and receive a 159 MHz frequency. This configuration does not allow lookouts to receive car-to-car traffic from mobiles without the use of a scanner.

Sometimes it is not desirable to position a transceiver at the point from which you wish to talk. A remote control unit is used in these circumstances to extend the control function to a place away from the transceiver.

Encoders/Decoders

Encoder: a device that generates an audible or subaudible signal to activate a decoder.

Decoder: a device that translates a received audible or subaudible signal into a command.

Some of the common encoders and decoders are burst-tone, Quick-call, CTCSS, and scramblers or voice-encryption.

Mobile Radios

A mobile radio is a transceiver placed in a vehicle or conveyance to permit communication while traveling or changing locations. Mobiles are generally more compact and rugged than base stations. A CDF mobile transmits on a 159 MHz frequency with tone leading the transmission for mobile relay activation, or on a 151 MHz frequency without tone for car-to-car use. Mobiles receive a 151 MHz frequency.

CDF uses two types of mobile radios:

1. **Crystal-controlled:** quartz crystals, vibrating at a precise frequency, determine the transmit and receive frequency of the radio. In order to perform both functions, one transmit and one receive crystal is needed for each frequency.

Crystal-controlled radios are identified by a numerical typing system. One type is a "444." The first digit indicates the number of mobile relay transmit frequencies. The second digit indicates the number of car-to-car (simplex) transmit frequencies. The third digit indicates the number of receive frequencies. Crystal-controlled mobiles are rapidly being phased out of CDF's mobile fleet.

2. **Synthesized:** utilize a crystal-controlled, stable reference frequency which, as the operator selects a channel, is electronically divided or multiplied to enable communications on the desired frequency.

Synthesizers allow multiple frequency options with the added benefit of compact or even subcompact size. Synthesized radios are either operator or radio technician programmable. Due to current FCC regulations, all CDF ground mobiles are technician programmable only. CDF aircraft, however, have radios programmable by either a technician or an aircrew member.

Incident base radios are mostly crystal-controlled, but will be upgraded to synthesized types as soon as possible.

Portable Radios (HTs)

These are small, hand-carried radios which operate on disposable or rechargeable dry batteries. The majority of CDF's portables are commonly referred to as Handie-Talkies (HTs). Their primary use is for incident tactical and command communications.

Older crystal-controlled HTs have been replaced systematically with modern, synthesized units capable of multifrequency operation in both simplex and repeater modes. While HTs are an indispensable component of the CDF radio system, they do have some disadvantages which radio users need to be aware of:

- Restricted to low wattage output, which limits transmitter range.
- Some of CDF's oldest HTs cannot access mobile relays.
- Use limited by battery life. Shelf-life of HT batteries can be prolonged by moderate refrigeration (do not freeze).
- Flexible rubber antennas used on most HTs reduce transmit efficiency.
- Small size and portability make HT radios especially vulnerable to theft, loss or damage.
- Transmit efficiency is reduced when user does not speak directly, at quite close range, into the microphone.

Porta-Mobile Radios

A porta-mobile is a small, hand carried radio which operates on dry batteries. When installed in a vehicle, with appropriate equipment, it doubles as a mobile radio. Several units have used local funds to purchase mobile adapters and chargers for use with the King 14-channel HT. The mobile adapter, among other things, boosts transmit power approximately 8 to 10 times.

CDF is not currently providing porta-mobiles to field units as part of normal radio complements.

Scramblers

A scrambler is a communications encoder/decoder device that purposely distorts and restores radio signals to provide message security. Voice encryption is another term for the process of scrambling radio messages. For obvious reasons, scramblers are used primarily by law enforcement personnel. CDF scramblers have multiple operating modes. In order to communicate, the transmitter and the receiver must be set in identical modes.

Aviation AM-VHF Radios

AM-VHF radios in the CDF system are in base station, mobile and portable configurations, and installed in rotary and fixed-wing aircraft. They are programmed with frequencies required for air operations and are amplitude-modulated (AM) instead of frequency-modulated (FM), like all other CDF radios.

These radios may be synthesized or crystal-controlled. They are used for air-to-air and air-to-ground communications, and by airtanker bases for ground communications with aircraft, airport officials and FAA control towers.

Aircraft Packset Radios

CDF uses two types of carry-on radio systems for use in call-when-needed hired aircraft. The older type of radio consists of a pair of 5-channel, lunch bucket style portables with connector cables and a headset. They are powered by D-cell flashlight batteries. They are rugged and reliable units, and are still adequate for basic recon, lightning strike detection missions, and (with qualified observer) air tactical coordination/supervision on small incidents. Their biggest drawbacks are frequency-limitation and inability to be reprogrammed in flight.

The newest type of aircraft packset consists of twin Bendix-King mobiles mounted in a custom-built case, with associated cabling and headsets for both observer and pilot, capable of either battery operation or running off the airplane's electrical system. Most of the new packsets are assigned in the northern region, where a substantial amount of lightning recon is flown each year by hired fixed-wing aircraft. The radios are operator-programmable and have a pilot/observer intercom similar to fully equipped CDF air tactical planes. In fact, these new packsets, coupled with the aircraft's own 720-channel Nav-Com radio, are quite capable of handling a complex air support operation.

Receivers

A receiver receives one or more preset radio frequencies. It has no transmit capabilities. The three basic types of receivers are:

- **Fixed Receiver:** receives a single frequency; usually associated with dispatch consoles.
- **Scanner:** continuously receives multiple frequencies; locks on to the first signal received. If the scanner has priority-scan capability, it will release any other frequency to capture a signal on the priority channel. Scanners are both crystal-controlled and programmable.
- **Pager/Alert Receivers:** a single frequency receiver, individually selectable by tone encoding equipment. Some pagers have monitoring and/or digital message readout capability.

DISPATCH CONSOLES

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CDF is replacing its old dispatch consoles on a regular schedule . All new consoles are microprocessor (computerized) units. They are extremely sophisticated and correspondingly expensive. CDF dispatch consoles are built, purchased and installed as modules. The term "operator position" is used to describe one fully furnished and electronically equipped workstation for one command center officer or operator. A console having 4 operator positions, therefore, is capable of simultaneous dispatching and communications by 4 individuals, with each person having access to the total electronics capability of the radio console. See the "ECC Console Replacement Plan" [{see exhibit}](#).

The CDF standard for unit ECCs and region CCs is three operator positions. Additional positions are justified based on dispatching workload and other factors such as interagency operations. When properly justified, small, portable "mini-consoles" may be included with the master console purchase. These units extend basic console capability to adjacent areas of the command or coordination center. Minis are used primarily during major-incident expanded operations.

Upgrade, replacement or relocation of a command center console is a complex and costly undertaking. It requires meticulous planning and should be handled with a teamwork approach. See Section 8007, Telecommunications Project Planning [{see section}](#).

In addition to detailed considerations of radio, microwave, telephone, computer and data processing issues, the planning process must also take into account a wide range of office efficiency and ergonomic factors. A few of these factors are:

- lighting for all command center work areas
- the need for sound-absorbing or deadening wall materials
- the need for sleeping, eating and coffee-break areas
- comfortable and rugged office furniture (good chairs are extremely important for all telecommunicators who spend long hours at a dispatch console)
- quiet, efficient air conditioning system
- major-incident expansion area and required equipment and furnishings
- storage area for maps, forms, status equipment, dispatch records, etc.

MOBILE COMMUNICATION CENTERS (MCCs)

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The CDF Mobile Communication Centers (MCCs) were designed to provide mobile communications capabilities equalling or surpassing those of the typical CDF command or coordination center and its dispatch console.

The MCCs are outfitted to provide radio communications capability not only on CDF frequencies, but also on those used by other public safety agencies including Federal, State, County and City entities. Their over-the-road mobility allows MCCs to travel to the scene of an emergency, establish a base of operations, and provide excellent communications capability even in remote areas where fixed communications facilities do not exist. The MCC's radio call numbers and assigned locations are:

- MCC #14 -Sonoma Unit
- MCC #24 -Shasta-Trinity Unit
- MCC #31 -Riverside Unit
- MCC #43 -Fresno-Kings Unit
- MCC #45 -Amador-El Dorado Unit

The MCCs have two primary roles: first, to travel to emergency incidents, as previously described, and provide incident communications; second, to provide temporary backup for an ECC unable to operate normally due to fire, construction, relocation, earthquake, etc. They are requested through normal ECC channels and will normally respond with two qualified MCC specialists aboard.

MCC technical-specialists have been formally trained in driving, setting-up, operating and maintaining the units. Local dispatch personnel, or dispatch overhead requested from out of unit, should be used to actually handle the local dispatch and communications work. The MCC technical specialists will provide basic training on-site and then go into a support mode for ongoing activity.

MCCs are equipped with a telephone key system, facsimile equipment, LAN computer system, HT cache, portable repeater, public address system, cellular phone lines, satellite telephone lines, cell phone cache, HAM station with packet, and a 20KW onboard generator. They are fully self-contained and include the ability to communicate on the following radio frequencies:

TRANSMIT AND RECEIVE

Band	Frequency	Typical User
1. H.F.	3 - 30 MHz	Amateur
2. VHF Low Band	29 - 50 MHz	CHP, OES
3. VHF Aeronautical	117 - 138 MHz	Air Traffic Control
4. VHF Amateur	144 - 149 MHz	Amateur
5. VHF High Band	150 - 174 MHz	CDF, USFS, BLM, NPS, OES
6. VHF Amateur	220 - 224 MHz	Amateur
7. UHF Federal	410 - 440 MHz	Federal public safety (this capability is not yet available in all MCCs)
8. UHF Amateur	440 - 445 MHz	Amateur
9. UHF Band	450 - 470 MHz	Public Safety
10. UHF Band	806 - 869 MHz	Public Safety, State Parks, Caltrans
11. KU Band	11.7 - 14.5 GHz	Satellite remote data & voice comm. link

RECEIVE ONLY

1. Wide Band: 25-999.999 MHz
 025-1.999 Ghz

2. Wide Band Scanning: 25-999.999 MHz

Units ordering the MCCs for incident communications should keep in mind that these are very large vehicles--over 37' long, 10' wide and 13' high. They are not suited for rough off-highway travel. Be realistic in choosing sites for MCC set-up.

Units housing the MCCs are permanently allocated \$7000 each per year for maintenance, repairs and routine operation of the MCCs. The units are provided funding for maintenance, repair and operation of the MCCs from the region-held account. This allows the region FEM II or region TCO the ability to prioritize allocations on a planned or emergency need, based on the individual MCC's need. Units housing MCCs will **NOT** be expected to fund the following:

- vehicle replacement
- computer hardware or software repair or replacement

- generator replacement
- air conditioner replacement
- radio and console repair or replacement
- satellite hardware repair or replacement

Most of the above costs will be borne by Sacramento Headquarters Telecommunications budget. Vehicle replacement funds will have to be obtained through the BCP or grant process.

RADIO MAINTENANCE AND REPAIR

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As required by State Administrative Manual (SAM) policy, Telecommunications Division, Department of General Services, maintains and repairs CDF radio equipment. The intent of SAM is to ensure that CDF and other radio-equipped state agencies receive necessary communications services which meet operational needs at minimum cost to taxpayers. Engineering services are centralized at Telecommunications Division headquarters in Sacramento. Maintenance shops and radio technicians are distributed throughout the state. See Section 8005 [{see section}](#).for additional information about the Telecommunications Division.

CDF TCOs are responsible for arranging and coordinating radio maintenance and repair in their respective administrative units. To reduce unnecessary expenditures, the TCO should be alert for radio problems stemming from improper use by radio operators. CDF has paid for numerous repair trips by technicians to fix radios which were functioning perfectly, but whose operators did not understand how to use them. Additionally, the TCO should do everything within reason to minimize travel and overtime work by radio technicians. When a new type of radio or accessory is to be installed in numerous vehicles, for example, it is usually cost-effective for the TCO to arrange for the vehicles to be available at the radio shop on a specified day, or days. This permits faster fleet conversion, and saves CDF big dollars.

The Department pays the Telecommunications Division an annual unit-cost maintenance fee for each piece of radio equipment. The fee is predicated on the total number of a given type and the past year's average cost to maintain. See the "Telecommunications Division Service Charges" [{see exhibit}](#).. Radio replacement occurs when equipment reaches an age beyond which reliable and economical service is no longer probable.

When the need for repair is confirmed, the TCO needs to obtain as much information as possible to assist the technician in isolating the trouble. For example: several mobile units are unable to activate a specific repeater; a mobile radio can receive but not transmit; one ECC console position cannot simulcast. This kind of information helps the technician lock in on the problem in the shortest possible time. The person who leaves a vehicle or portable radio at the radio shop with a note saying "--it doesn't work right" may or may not get the right thing fixed, but he/she will certainly have boosted the cost of repair.

The TCO deals directly with the appropriate local radio shop. Normal repairs to CDF equipment do not usually require paperwork, but it is good procedure to always document repair requests, and completion dates. When local technicians are unavailable, requests should go to the area supervisor. A TCO experiencing difficulty with a particular shop or technician should carefully document every event of significance. Early on, contact the area supervisor and attempt to work out a satisfactory solution. If the problem cannot be resolved readily between the unit TCO and area supervisor, the region TCO should be contacted for consultation on further action at a higher level.

Good working relationships are the rule, rather than the exception, between CDF and the radio maintenance shops. It is to everyone's advantage for all TCOs to work diligently on this aspect of telecommunications management.

RADIO INSTALLATION AND MODIFICATION

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Radio installations and modifications are accomplished by Telecommunications Division field technicians in response to an approved Telecommunications Work Authorization. Form COM-207--see forms Section 8060 {see section}.for instructions and exhibit. The COM-207 is used by TCOs at all levels in CDF-unit, region and department headquarters.

Blanket authorizations (preapproval by CDF fire control operations) are provided for the following job types:

- handi-talkie repair
- emergency incident operations (example: a radio technician on standby at incident base)
- CDF aircraft radio maintenance
- mobile radio programming and installation
- damage repair (vehicle collisions, storm damage to antennas, vandalism, normal wear-and-tear, etc.)
- radio technician checkout of mobile radios installed by CDF personnel (CDF automotive shop personnel usually handle all fleet radio installs)

For large installation projects involving many statewide facilities, or for sizeable numbers of CDF's vehicle fleet, it is common practice for the senior TCO or staff assistants to prepare a master COM-207 covering the entire project. This greatly simplifies the paperwork process for the Telecommunications Division as well as for CDF field TCOs. In all such cases, copies of the approved COM-207 are routed to all concerned TCOs, and project coordination is provided to the field by HQ staff.

Copies of completed COM-207s with attached plot plans, drawings and wiring diagrams should be obtained from the technician and retained. These documents, together with equipment inventories, serve as a reference to help detect unauthorized modifications and as a model for future work orders.

The individual TCO will undoubtedly be the recipient of occasional ill-considered or even frivolous requests for radio modifications. It is the TCO's responsibility to discourage such requests, explaining that CDF's telecommunications budget barely covers essential, high-priority work. There simply are no funds for whimsical or nice-to-have radio modifications. Some unauthorized modifications in the past have circumvented the grounding protection, causing damage to consoles and phone systems during lightning storms. Any modifications should be made by Telecommunications Division Technicians to assure proper system compatibility.

FORMS AND/OR FORMS SAMPLES: RETURN TO ISSUANCE HOME PAGE FOR FORMS/FORMS SAMPLES SITE LINK.

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